

CLAIMS

What is claimed is:

1 1. A method for reducing spurious emissions in an amplified signal by applying pre-distortion,
2 whose magnitude is frequency-dependent, to an input signal to generate a pre-distorted signal, such that,
3 when the pre-distorted signal is applied to an amplifier to generate the amplified signal, the pre-distortion
4 reduces spurious emissions in the amplified signal, wherein the pre-distorted signal is generated by:

5 (a) generating a positive-frequency pre-distortion signal corresponding to positive-frequency
6 components of the input signal;

7 (b) generating a negative-frequency pre-distortion signal corresponding to negative-frequency
8 components of the input signal; and

9 (c) combining the positive- and negative-frequency pre-distortion signals to generate the pre-
10 distorted signal.

1 2. The invention of claim 1, wherein the phase of the pre-distortion is also frequency-dependent.

1 3. The invention of claim 1, wherein:

2 the positive-frequency pre-distortion signal is generated by:

3 (1) generating a first set of one or more waveforms corresponding to a first set of one or more
4 pre-distortion parameters;

5 (2) differentiating the first set of one or more waveforms with respect to time to generate a first
6 set of one or more differentiated waveforms; and

7 (3) applying the first set of one or more differentiated waveforms to a positive-frequency
8 operation to generate the positive-frequency pre-distortion signal; and

9 the negative-frequency pre-distortion signal is generated by:

10 (1) generating a second set of one or more waveforms corresponding to a second set of one or
11 more pre-distortion parameters different from the first set of one or more pre-distortion signals;

12 (2) differentiating the second set of one or more waveforms with respect to time to generate a
13 second set of one or more differentiated waveforms; and

14 (3) applying the second set of one or more differentiated waveforms to a negative-frequency
15 operation to generate the negative-frequency pre-distortion signal

1 4. The invention of claim 3, wherein the first and second sets of one or more pre-distortion
2 parameters are retrieved from look-up tables using an index value based on a power level of the input
3 signal.

1 5. The invention of claim 4, wherein the power level is a function of I^2+Q^2 , where the input signal is
2 represented by I and Q signals.

1 6. The invention of claim 3, wherein the positive- and negative-frequency operations are
2 implemented using filters.

1 7. The invention of claim 3, wherein:
2 the first set of one or more waveforms is differentiated before being applied to the positive-frequency
3 operation; and
4 the second set of one or more waveforms is differentiated before being applied to the negative-
5 frequency operation.

1 8. The invention of claim 1, further comprising the steps of:
2 generating a frequency-independent pre-distorted signal from the input signal; and
3 combining the frequency-independent pre-distorted signal and the positive- and negative-frequency
4 pre-distortion signals to generate a combined pre-distorted signal.

1 9. The invention of claim 1, wherein:
2 the input signal is represented in a base-band domain; and
3 the positive- and negative-frequency pre-distortion signals are generated in a digital domain.

1 10. An apparatus for applying pre-distortion to an input signal to generate a pre-distorted signal, such
2 that, when the pre-distorted signal is applied to an amplifier to generate an amplified signal, the pre-
3 distortion reduces spurious emissions in the amplified signal, the apparatus comprising:

4 (a) a main signal processing path adapted to generate a main pre-distortion signal from the input
5 signal;

6 (b) a positive-frequency secondary signal processing path adapted to generate a positive-frequency
7 pre-distortion signal corresponding to positive-frequency components of the input signal;

8 (c) a negative-frequency secondary signal processing path adapted to generate a negative-frequency
9 pre-distortion signal corresponding to negative-frequency components of the input signal; and

10 (d) a combiner adapted to combine the positive- and negative-frequency secondary pre-distortion
11 signals with the main pre-distortion signal to generate the pre-distorted signal.

1 11. The invention of claim 10, wherein the phase of the pre-distortion is also frequency-dependent.

1 12. The invention of claim 10, wherein:
2 the main signal processing path is adapted to generate a frequency-independent pre-distorted signal
3 from the input signal;
4 the positive-frequency secondary signal processing path is adapted to generate the positive-frequency
5 pre-distortion signal by:
6 (1) generating a first set of one or more waveforms corresponding to a first set of one or more
7 pre-distortion parameters;
8 (2) differentiating the first set of one or more waveforms with respect to time to generate a first
9 set of one or more differentiated waveforms; and
10 (3) applying the first set of one or more differentiated waveforms to a positive-frequency
11 operation to generate the positive-frequency pre-distortion signal; and
12 the negative-frequency secondary signal processing path is adapted to generate the negative-
13 frequency pre-distortion signal by:
14 (1) generating a second set of one or more waveforms corresponding to a second set of one or
15 more pre-distortion parameters different from the first set of one or more pre-distortion signals;
16 (2) differentiating the second set of one or more waveforms with respect to time to generate a
17 second set of one or more differentiated waveforms; and
18 (3) applying the second set of one or more differentiated waveforms to a negative-frequency
19 operation to generate the negative-frequency pre-distortion signal.

1 13. The invention of claim 12, wherein the first and second sets of one or more pre-distortion
2 parameters are retrieved from look-up tables using an index value based on a power level of the input
3 signal.

1 14. The invention of claim 13, wherein the power level is a function of I^2+Q^2 , where the input signal
2 is represented by I and Q signals.

1 15. The invention of claim 12, wherein the positive- and negative-frequency operations are
2 implemented using filters.

1 16. The invention of claim 12, wherein:
2 the first set of one or more waveforms is differentiated before being applied to the positive-frequency
3 operation; and

4 the second set of one or more waveforms is differentiated before being applied to the negative-
5 frequency operation.

1 17. The invention of claim 12, wherein:

2 the main signal processing path comprises:

3 (1) an index generator adapted to generate index values proportional to envelope power of the
4 input signal; and

5 (2) a first look-up table adapted to provide first and second pre-distortion parameters using the
6 index values;

7 the positive-frequency secondary signal processing path comprises:

8 (1) a second look-up table adapted to provide third and fourth pre-distortion parameters using the
9 index values;

10 (2) a multiplier adapted to multiply the input signal by the third and fourth pre-distortion
11 parameters to generate first multiplied signals;

12 (3) a differentiator adapted to differentiate the first multiplied signals with respect to time to
13 generate first differentiated signals; and

14 (4) a positive-frequency filter adapted to filter the first differentiated signals; and

15 the negative-frequency secondary signal processing path comprises:

16 (1) a third look-up table adapted to provide fifth and sixth pre-distortion parameters using the
17 index values;

18 (2) a multiplier adapted to multiply the input signal by the fifth and sixth pre-distortion
19 parameters to generate second multiplied signals;

20 (3) a differentiator adapted to differentiate the second multiplied signals with respect to time to
21 generate second differentiated signals; and

22 (4) a negative-frequency filter adapted to filter the second differentiated signals..

1 18. The invention of claim 10, wherein:

2 the input signal is represented in a base-band domain; and

3 the positive- and negative-frequency pre-distortion signals are generated in a digital domain.